SESAME (KENYA) PROJECT

Final Report for the

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE,
OTTAWA, CANADA

P.O. Ayiecho and J.O. Nyabundi
Department of Crop Science
University of Nairobi
P.O. Box 29053
NAIROBI, KENYA.

DECEMBER 1992

CONTRIBUTIONS

The following persons contributed to the work in this report.

Dr. P.O. Ayiecho	**Project Leader Researcher**
Dr. J.O. Nyabundi	**Researcher**
Mr. K.W. Nyabundi	**Research Assistant**
Mr. J.O. Nyanapah	**M.Sc. Student**

CONTENTS

DECLARATION

The work in this report was supported by International Development Research Centre, Ottawa, Canada.

2. INTRODUCTION

This is the second and the final report of the two-year Sesame (K) project which was initiated in September 1990. It highlights the findings of sesame research conducted in Coastal Province between September 1990 and August 1992.

The first part of the report gives a brief summary of the findings for the first year of the project (September 1990 to August 1991). The project's first year results are detailed in the First Year Technical Report submitted to International Development Research Centre in October 1991. The second part of the report details the results of agronomic and varietal development field experiments. The agronomic experiments were conducted on sesame fertilizer requirements and response of sesame growth and yield to varied soil water conditions. The varietal development section outlines the results of germplasm assembly, screening of the assembled germplasm for improved adaptability, yield and disease resistance. Finally a set of recommendations are made for the farmers and for further research.

3. Summary of Year I Results

The results of Year I work was detailed in the first technical report of September 1991. Provided below are just the main highlights.

3.1. Agronomic Experiments

3.1.1. Field Survey

Analysis of survey data obtained from 51 sesame farmers in Kwale and Kilifi districts led to the following preliminary agronomic recommendations:

(i) Sesame should be thinned to 4 to 10 plants per hill with spacing of 90cm x 60cm in a relay crop system.

(ii) Sesame be fertilized or the crop immediately preceding sesame in a relay cropping system be fertilized. The appropriate fertilizer or farm yard manure rate was yet to be determined.

(iii) Sesame be planted as a pure stand. It can be relayed with other crops so long as its planting is timed in such a way that it is not subjected to undue competition during early growth.

(iv) Sesame be planted during the main rains in CL_4 and CL_5 agroecozones of the districts where June/July rains are unreliable.

3.1.2. Plant density studies

It was found that increasing plant population from 50×10^3 to 700×10^3 plants per hectare had no significant effects on sesame yield. The genotypes under study (local landraces) exhibited morphological plasticity which allowed them to produce many and vigorous branches at low densities which fully compensated for the reduction in seed rates. It was concluded that of 60 x 15 cm which gives about 111×10^3 plants per hectare should be adopted in pure stands.

3.2. Germplasm aquisition and varietal development

A total of 109 germplasm accessions were collected during the first year of the project. Twenty-two of these were of locally acquired while 87 were of foreign origin.

The germplasm accessions were subjected to botanical studies and primary evaluations at Mtwapa during the short rains of 1990/91. Seven qualitative descriptors, namely growth habit, stem pubescence, stem fasciation, petiole colour, midrib colour, leaf margin colour, top leaf surface hairiness, bottom leaf surface hairiness, capsule pubescence, locules per capsule and seed colour, were used to characterise the accessions. The accessions were observed to be quite variable for plant height, height of first capsule, height of first branch, capsules on the main stem, capsules per plant, stem length from first capsule to tip, number of capsule bearing branches per plant and seed yield per plant.

Cercospora leaf spot and webworm were noted on most of the accessions, particularly those that were of foreign origin and black seeded local landraces. A number of accessions were noted to be promising based on vigour, capsule production, seed yield, lack of disease and pest infestation and lack of lodging.

Single plant selection was initiated on the germplasm accessions at Mtwapa during the short rains of 1990/1991. A total of 123 single plants were selected, based on vigour, capsule production, low disease and pest incidence and lack of lodging.

The project's first year experiments are detailed in the First Technical Report of the Project.

4. YEAR II EXPERIMENTS

4.1 AGRONOMIC EXPERIMENTS

Two agronomic experiments were conducted to address the following objectives:

1. Investigate response of sesame growth and yield to Nitrogen and Phosphatic fertilizers.
2. Study sesame water requirements with regard to growth and yield.

Experiment 1

Effect of Nitrogen and Phosphatic fertilizer levels on sesame growth and yield.

Introduction

Sesame is an established indigenous crop but its yields remain low. Farmers' average yield is about 200kg ha^{-1} while research station trials have realised yields in excess of 2000kg ha^{-1} using the same varieties (Ayiecho et al, 1991). This is an indication that improvement of agronomic practices can lead to large increases in sesame yields.

Use of fertilizers has caused a major contribution in increasing crop yields (Harre and White, 1985; FAO, 1984) and higher crop yields have been obtained in countries with higher fertilizer consumption (FAO, 1984). Requirements for Nitrogen exceed that of any other plant nutrient and very rarely do soils, especially in the tropics, have enough nitrogen to produce high sustainable yields (Wrigley, 1992; Harre et al, 1985). It is therefore necessary to restore and maintain soil nitrogen by maintaining a high level of organic matter in the soil but this often needs to be supplemented with inorganic nitrogen fertilizers for efficient crop production.

Phosphorus is the second most common nutrient limiting crop production in the tropics (Wrigley, 1982). A moderate to high deficiency of phosphorus is widespread throughout tropical Africa and use of inorganic phosphatic fertilizers is inevitable if high yields are to be obtained.

Sesame is generally cultivated by small scale farmers over a greater part of its range, usually under low standards of husbandry and little or no fertilizer application. This has led to a general misconception that it is adapted to poor soils and responds poorly to fertilizer application. However, as Weiss (1971) rightly pointed out, whereas the landraces developed under low management and low input conditions may not respond significantly to applied fertilizer, improved varieties capable of high yields will need additional plant nutrients to optimize returns. For America conditions, Langham, (1985) noted that sesame grows best on fertile soils, heavy applications of commercial fertilizers being required where soil fertility is not adequate. Little has been done to investigate fertilizer requirement of sesame in Kenya and the limited information available is characteristically sporadic with contradictory and inclusive results. a fertilizer rate experiment in 1968 reported highest yield with 39Kg ha^{-1} N and 105 Kg ha^{-1} P_2O_5 under irrigation. Trials in Lamu showed that application of fertilizers depressed yield (Gichuki and Gethi, 1988). In work done at Mtwapa, residual fertilizer applied to maize was shown to benefit sesame planted in relay later in the season (Gethi 1990).

Ayiecho et al (1991) obtained similar results in a survey which showed that farmers who applied fertilizers or manure to maize harvested higher yields of relay planted sesame growing later in the season.

This experiment was conducted to provide a well controlled evaluation of the effects of N and P on sesame growth and yield.It is expected to be repeated over a number of seasons and sites to provide a comprehensive fertilizer study.

Materials and Methods

Two experiments were conducted at Kenya Agricultural Research Institute regional centre at Mtwapa. The first experiment was conducted between August and November, 1991 and second experiment was conducted between March and July 1992. Each experiment consisted of three treatments namely two varieties (V_1 black-seeded landrace and V_2 white-seeded landrace), four levels of Nitrogen (N_0 = 0kg, N ha^{-1}, N_{50} = 50 kg N ha^{-1}, N_{100} = 100kg N ha^{-1}, N_{150} = 150 kg N ha^{-1}) and four levels of phosphorus (P_0 = 0kg P ha^{-1}, P_{30} = 30 kg P ha^{-1}, N_{60} = 60 kg P ha^{-1}, N_{90} = 90 kg P ha^{-1}). Nitrogen was applied as Calcium Ammonium Nitrate (CAN, 26%N) and phosphorus as Triple Super Phosphate (TSP, 46% P_2O_5). Both nitrogen and phosphorus fertilizers were applied at planting.

The experiments were each arranged in a complete randomised block designed with a 2V x 4N x 4P factorial structure. Each treatment was replicated 3 times in plots which measured 3m x 3m.

The experimental plots were ploughed and harrowed to give moderate tilth. Sesame seeds were drilled in rows 60cm apart. After three weeks the stands were thinned to leave an intrarow spacing of 15cm. Manual weeding was done three times to keep the fields clean. There were no significant pest or disease problems.

The following data were recorded at crop maturity:

Plant height, number of primary branches length of primary branches, Height to first branch and first pod, final seed yield and 1000 seed weight. For these measurements, plants falling within 1m stretch in a row were used. Two such 1m long stretches falling on two randomly selected rows were used in each plot. Hence the area used for this purpose was $1.2m^2$. It was found necessary to use contiguous rather than randomly selected plants, in order to even out effect of compensatory growth so rampant in sesame.

Data collected was subjected to analysis of variance.

Result and Discussions

Plant height was not affected by the treatments in season 1 (Table 1.1a). In season 2 the black variety (V_1) had significantly taller plants than white (V_2) (Table 1.1b) but the fertilizer treatments had no effect even in this season. Similarly fertilizer treatments did not significantly affect height to first capsule in both seasons (Table 1.2a and 1.2b) but this parameter was significantly larger in black variety than white in both seasons. The height to first capsule is an important parameter affecting prolificacy of cultivated sesame varieties. Some wild species such as Sesamum calycinum produce capsules almost throughout the entire length of the main stem and branches. If this trait could be incorporated in cultivated sesame through management or breeding the capsule and seed yield would increase remarkedly. Comparing the two varieties capsule formation started higher in the black variety than the white. Averaging both seasons the capsule producing length in black variety was about 40% of total plant height compared to 50% of the white variety. This is likely to give the black variety a smaller harvest index than the white variety indicating lower efficiency of partitioning of assimilates into the economic yield.

Table 1.1a: Plant Height (cm/plant) at maturity in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	96.57	104.94	90.93	79.00	92.9
P_1	92.27	105.20	86.20	90.53	93.6
P_2	92.43	102.32	93.60	99.33	96.9
P_3	91.37	100.73	93.26	91.43	94.4
N	93.16	103.30	91.00	90.07	94.4
	White seeded landrace				
P_0	78.10	81.83	101.40	76.73	84.5
P_1	98.23	99.23	103.16	78.47	94.8
P_2	99.97	84.60	78.87	77.93	85.3
P_3	89.90	96.53	90.57	103.80	95.2
N	91.55	90.55	93.50	84.23	90.0

Table 1.1b Plant Height (cm/plant) at maturity season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	104.82	115.17	115.86	115.07	112.7
P_1	119.33	111.55	117.07	114.55	115.6
P_2	128.22	107.43	111.52	117.64	116.2
P_3	114.31	112.34	125.42	104.00	114.0
N	116.67	111.62	117.47	112.82	114.6
	White seeded landrace				
P_0	103.00	103.95	101.90	112.13	105.3
P_1	99.83	111.57	112.60	110.33	108.6
P_2	103.90	114.83	106.34	105.58	107.7
P_3	107.14	109.02	112.98	108.02	109.3
N	103.47	109.84	108.46	109.02	107.7

Table 1.2a Height at first capsule (cm/plant) in season 1

	N_0	N_1	N_2	N_3	P
	Black Seeded landrace				
P_0	48.33	53.17	60.60	46.30	52.1
P_1	62.67	60.37	63.99	49.67	59.2
P_2	63.23	56.93	46.13	48.07	53.6
P_3	55.30	60.20	54.70	62.60	58.2
N	57.38	57.67	56.36	51.66	55.8
	White seeded landrace				
P_0	50.33	45.53	45.26	40.50	45.4
P_1	47.77	50.63	43.33	44.00	46.4
P_2	48.87	49.68	46.80	46.90	48.1
P_3	48.97	50.73	43.40	47.07	47.5
N	48.99	49.14	44.70	44.62	46.9

Table 1.2b: Height at first capsule (cm/plant) season 2

	N_0	N_1	N_2	N_3	P
	Black Seeded landrace				
P_0	65.44	62.95	67.76	69.40	66.4
P_1	67.58	65.05	73.36	69.09	68.8
P_2	68.07	62.83	64.04	62.45	64.4
P_3	74.38	66.32	71.95	61.93	68.7
N	68.87	64.29	69.28	65.72	67.0
	White seeded landrace				
P_0	48.64	46.69	53.14	49.28	49.4
P_1	56.38	56.56	55.00	48.76	54.2
P_2	49.59	48.02	54.98	48.79	50.4
P_3	54.07	49.19	56.40	51.52	52.8
N	50.17	50.12	54.88	49.59	51.7

When the local sesame landraces are planted at optimal densities they branch freely producing robust primary branches and most of their capsules are borne on these primary branches. It would therefore be of agronomic importance that production of primary branches starts early in the plants life cycle. In the first season experiment increase in nitrogen level significantly decreased height to first branching in both varieties (Table 1.3a) though branching started significantly higher in black than white varieties. Effect of phosphorus was not significant. Effect of fertilizer treatments was not significant in second season (Table 3b) but branching still started at significantly higher point in black than white varieties.

Given the compensatory growth of sesame plants number of branches per plant and branch length per plant would each vary widely as vigorous plants smother their weaker neighbours. The two parameters were thus expressed per unit land area to even out these differences. The treatments did not have significant affects on number of branches.

(Table 1.4a) and branch length (Table 1.5a) in first season. In the second season, however, black variety had significantly larger number of branches (Table 1.4b) but there were no treatment effects on branch length which were also longer than those of the white variety.

Table 1.3a: Height to first branch (cm/plant) in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	23.50	25.70	27.50	21.83	24.6
P_1	23.03	24.03	21.84	17.39	21.6
P_2	26.30	28.57	20.00	19.77	23.7
P_3	24.80	24.07	21.00	22.93	23.2
N	24.41	25.59	22.59	20.48	23.3
	White seeded landrace				
P_0	14.23	16.19	13.90	13.70	14.5
P_1	21.47	15.87	16.67	16.10	17.5
P_2	22.30	15.15	15.77	15.90	17.0
P_3	19.20	17.63	14.63	16.63	16.6
N	19.30	16.21	15.24	15.58	16.6

Table 1.3b: <u>Height to first branch (cm/plant) season 2</u>

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	16.79	13.76	17.76	18.14	16.6
P_1	17.22	20.88	18.98	19.69	19.2
P_2	21.34	24.16	16.78	15.78	19.5
P_3	21.76	13.95	19.95	19.76	18.9
N	19.28	18.19	18.37	18.34	18.6
	White seeded landrace				
P_0	17.10	15.00	12.29	14.71	14.8
P_1	14.43	18.62	16.09	18.76	17.0
P_2	16.83	13.14	19.95	14.17	16.0
P_3	15.43	12.05	18.86	13.93	15.1
N	15.95	14.70	16.80	15.39	15.7

Table 1.4a: Number of branches/m^2 at harvest in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	70.67	68.00	87.95	66.22	73.2
P_1	90.22	96.89	104.40	91.96	95.9
P_2	91.11	73.33	67.56	70.67	75.7
P_3	76.00	83.11	81.33	100.44	85.2
N	82.00	80.33	85.31	82.32	82.5
	White seeded landrace				
P_0	77.33	69.64	81.78	69.34	74.6
P_1	67.56	77.33	71.56	76.00	73.1
P_2	70.22	88.58	88.00	80.00	81.7
P_3	71.11	87.55	77.78	84.44	80.2
N	71.56	80.78	79.78	77.45	77.4

Table 1.4b: Number of branches/m^2 at harvest in season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	79.68	71.93	70.83	72.49	73.7
P_1	78.02	63.08	70.83	72.49	71.1
P_2	68.06	64.74	71.38	73.042	69.3
P_3	79.13	81.34	78.57	63.084	75.5
N	76.22	70.27	72.90	70.282	72.4
	White seeded landrace				
P_0	54.78	53.67	61.97	59.21	57.4
P_1	64.19	61.42	68.06	60.31	63.5
P_2	53.95	60.31	53.12	65.29	58.2
P_3	63.63	72,49	68.61	63.08	67.0
N	59.14	61.97	62.94	61.97	61.5

Table 1.5a: Branch lenght (cm/m^2)in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	2045.12	2196.57	3649.23	2250.08	2535.3
P_1	4182.10	3994.84	4898.76	3306.43	4095.5
P_2	3657.98	2206.92	2354.57	2474.12	2673.4
P_3	2849.88	3537.21	3193.40	4607.04	3546.9
N	3183.77	2983.89	3523.99	3159.42	3212.8
	White seeded landrace				
P_0	3736.44	3555.85	3735.80	3100.40	3532.1
P_1	2929.25	3959.49	3391.85	3392.77	3418.3
P_2	3032.63	4674.33	3834.67	4064.62	3901.6
P_3	3140.34	4303.38	3969.65	3826.93	3810.1
N	3209.67	4123.26	3732.99	3596.18	3665.5

Table 1.5b: Branch length cm/m^2 in season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	4132.16	4246.34	3953.90	4005.50	4084.5
P_1	4867.40	3056.86	3895.42	4298.02	4029.4
P_2	4450.02	3692.94	3596.06	4251.18	3997.6
P_3	4428.19	4850.91	4906.93	3080.82	4316.7
N	4469.44	3961.76	4088.08	3908.84	4107.1
	White seeded landrace				
P_0	3056.09	3223.66	3110.34	3687.94	3269.5
P_1	3841.96	3568.78	3786.90	3400.95	3649.7
P_2	2993.50	3982.04	2950.04	3200.12	3281.4
P_3	3582.47	4447.59	4320.18	3782.59	4033.2
N	3368.51	3805.52	3541.87	3517.90	3558.4

Table 1.6a: Grain Yield (Kg/ha)

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	65.61	90.33	161.47	66.59	96.0
P_1	290.10	252.13	249.64	55.09	211.7
P_2	134.94	74.56	68.94	78.57	89.3
P_3	106.97	166.90	116.81	128.12	129.7
N	149.41	145.98	149.22	82.09	131.7
	White seeded landrace				
P_0	261.58	304.11	214.49	93.56	218.4
P_1	253.95	431.77	124.72	192.82	250.8
P_2	301.75	285.59	208.33	242.27	259.5
P_3	259.06	269.35	241.74	272.08	260.6
N	269.09	322.71	197.32	200.18	247.3

Table 1.6b: Grain Yield (Kg/ha) in season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	368.06	582.87	448.72	534.21	483.5
P_1	591.50	580.33	462.67	623.20	564.4
P_2	661.90	454.04	591.01	692.30	599.8
P_3	569.70	560.29	545.93	409.96	521.5
N	547.79	544.38	512.08	564.92	542.3
	White seeded landrace				
P_0	696.20	852.53	522.95	704.93	694.2
P_1	587.08	735.15	788.16	577.58	672.0
P_2	467.46	912.20	530.31	456.96	522.9
P_3	656.82	916.20	545.94	689.45	702.1
N	601.89	785.16	596.84	607.23	647.8

Yield of sesame in both seasons was significantly higher in white variety than black (Tables 1.6a and 1.6b). The fertilizer treatments did not affect yield in these experiments. Considering the yield components, the white variety had significantly more capsules per unit land area than the black variety in both seasons (Tables 1.7a and 1.7b). On the other hand, the black variety had a higher 1000gram weight than the white (Tables 1.8a and 1.8b). Fertilizer treatments had no effect on these parameter in both experiments.

In general, crop performance in both seasons was below expected average due to weather factors. In the first season the rains failed and the crop was subjected to drought stress through most of their growing period. The result was short low yielding plants. Although sesame is relatively tolerant to drought adequate moisture is necessary for high yields. Delikostadinor (1985) and Beech (1985) reported that sesame growth can be greatly retarded by prolonged drought. In the second season, conversely, there was a lot of rain which persisted for about a month from planting and affected crop emergence and establishment. These weather factors must have overshadowed any response of sesame to applied fertilizers. In addition, a study of the sesame roots showed heavy mycorrhizal infection. This may limit response of the crop to fertilizers particularly the less mobile phosphates. It should also be pointed out that both sesame varieties are indigenous landraces which have evolved under low input, small scale farmers' systems. Such varieties characteristically respond little to added inputs. Further experiments will be done to include more representative seasons and effects of mycorrhizae on sesame response to fertilizers.

Table 1.7a: Number of Capsules/m^2 in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	403.11	533.78	765.34	480.00	546.0
P_1	780.89	760.00	901.73	653.51	774.0
P_2	717.33	469.33	507.55	471.56	541.4
P_3	504.44	728.89	587.56	900.45	680.3
N	601.44	623.00	690.55	626.38	635.3
	White seeded landrace				
P_0	910.22	1028.85	938.22	737.35	903.7
P_1	664.89	1028.44	798.67	881.33	843.3
P_2	900.44	1242.00	1013.78	1007.11	1040.8
P_3	818.22	1118.69	1126.22	953.33	1004.1
N	823.44	1104.49	969.22	894.78	948.0

Table 1.7b: Number of Capsules /m^2 in season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	767.34	1008.73	964.46	943.71	921.1
P_1	1039.16	724.87	999.99	1071.81	959.0
P_2	1055.76	790.16	849.37	1008.17	925.9
P_3	897.51	1237.81	932.37	737.04	951.2
N	939.94	940.39	936.55	940.18	939.3
	White seeded landrace				
P_0	918.53	1109.43	1038.05	1126.59	1048.2
P_1	937.35	1081.21	1113.03	1171.96	1003.5
P_2	868.73	1122.99	948.41	1074.02	1234.1
P_3	1108.88	1383.89	1303.10	1140.42	1090.4
N	958.37	1174.38	1100.65	1128.25	1094.1

Table 1.8a: 1000 seed weight (gm) in season 1

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	2.89	3.55	3.48	3.46	3.4
P_1	3.07	3.43	3.44	3.40	3.3
P_2	3.37	3.50	3.44	3.47	3.5
P_3	3.43	3.40	3.39	3.31	3.4
N	3.19	3.47	3.44	3.41	3.4
	White seeded landrace				
P_0	2.21	2.32	2.29	2.29	2.3
P_1	2.24	2.33	2.24	2.36	2.3
P_2	2.18	2.31	2.23	2.33	2.3
P_3	2.22	2.26	2.33	2.29	2.3
N	2.21	2.31	2.27	2.32	2.3

Table 1.8b: 1000 Grain weight (g) in season 2

	Black Seeded landrace				
	N_0	N_1	N_2	N_3	P
P_0	3.40	3.45	3.41	3.25	3.4
P_1	3.49	3.38	3.33	3.44	3.4
P_2	3.50	3.54	3.37	3.40	3.5
P_3	3.45	3.38	3.46	3.30	3.4
N	3.46	3.44	3.39	3.35	3.4
	White seeded landrace				
P_0	2.43	2.46	2.46	2.45	2.5
P_1	2.42	2.50	2.53	2.51	2.5
P_2	2.45	2.54	2.57	2.46	2.5
P_3	2.49	2.53	2.49	2.50	2.5
N	2.45	2.51	2.51	2.48	2.5

Literature Cited

1. Ayiecho, P.O., J.O. Nyabundi and K.W. Nyabundi. 1991. Sesame (Kenya) Project. First technical report. International Development Research Centre, Ottawa, Canada.

2. Beech, D.F. 1985. Sesame production and potentials in Australia. In Sesame and Safflower. Status and potentials pp. 77 - 122. FAO, Rome.

3. Delikostadinor S. G. 1985. Condition and methods for the improvement of sesame production, growth methods and plant production in Bulgaria. In Sesame and Safflower: Status and potentials. FAO, Rome.

4. FAO. 1984. Fertilizer and plant nutrition Guide. FAO. fertilizer and plant nutrition bulletin.

5. Gethi, J.G. 1990. Effects of plant population and residual fertilizer on grain yields of sesame relayed with maize. Proceedings, 2nd Annual KARI Scientific Conference 5th - 8th Sept. 1990.

6. Gichuki S.T. and Gethi J.G. 1988. Sesame research work at the Regional Research Centre - Mtwapa, Kenya. A review of past work, potential and future prospects. Proceedings of the 4th oilcrops network workshop, held at Njoro. pp. 32 - 39.

7. Harre, E.A. and W.C. White. 1985. Fertilizer market profile: In fertilizer technology and use. O.P. Eneglstd (ed). Soil Science Society of America Inc. Madison Wisconsin U.S.A. 3rd Edition 1: 1 - 23.

8. Langham 1985. Growing sesame in desert South West U.S.A. In. Sesame and Safflower: Status and potentials. FAO Plant production and protection paper N. 66.

9. Weiss, E.A. 1971. Castor, Sesame and Safflower. Leonard Hill. London. 1971. pp. 309 - 525.

10. Wrigley, G. 1981. Tropical Agriculture. The development of production. Longmans. pp. 163 - 172.

Experiment 2

Response of plant water status, growth and yield of sesame to soil water deficits.

Introduction

Sesame production in the Coastal lowlands (CL) of Kenya covers agroclimatic zones 3, 4 and 5. The latter two are considered marginal for crop production because of low and unreliable rainfall. For sesame the situation is further aggravated by a traditional practice in which the crop is planted during mid-year (June, July, August) rains as opposed to the staple crops which are planted at the beginning of main rains in March. Experience has shown that sesame does well during this period of relatively low rainfall. However, the reliability of those rains, particularly in CL_4 and CL_5 agroecozoness, is such that total crop failure is common. Moreover, in order to counteract the unreliable rainfall, farmers do gamble and plant sesame whenever rain falls during this period. If rain disappears after such an episode, the emerging seedlings are lost. This bet-hedging practice may exhaust farmers' seed stock. Indeed it was found that lack of planting seed is one of the factors limiting sesame production in much of Kilifi district. (Ayiecho et al, 1991). In view of this situation, the need to identify and/or develop drought resistant sesame varieties can not be overemphasized. Elsewhere in Western Kenya such varieties can be utilised during the often unreliable short rains.

It is increasingly acknowledged that understanding of basic physiological mechanisms of drought resistance is essential for rapid advancement in identification of resistant genotypes. However, studies on water relations of sesame has received very little attention worldwide. Hall and Yermanos (1975) reported varietal differences in stomatal conductance in sesame but the merits of this traits regarding crop growth and yield was not established. In this experiment growth and yield of four sesame varieties were examined under different watering regimes. Sesame leaf water status was also monitored. the aim was to identify varietal differences that may be used in further selection.

Materials and Methods

A field experiment was conducted at University of Nairobi's dryland field station, Kibwezi between May and August 1992. This is a dry period in the area and there was not a single episode of rainfall. Four sesame varieties namely SIK 020 (V_1 local black landrace), SIK 0073 (V_2, from India), SIK 090 (V_3, from U.S.A) and SPS SIK 112 (V_4, selection from local white landrace) were used.

The sesame varieties were subjected to three watering levels High (H) medium (M) and low (L) in a split plot design replicated four times. The irrigated levels constituted the main treatments (main plots) and the sesame varieties were allocated to the sub-plots. Each sub-plot measured 3m x 2m.

Irrigation water was applied using a line-source sprinkler irrigation system which provides a moisture gradient decreasing with increasing distance from the sprinkler line (Hanks et al, 1976). The sprinkler was laid at one edge of the plots so that only one side of the throw was used. In this way differences in wind drift effect were, avoided and uniform water distribution ensured. Irrigation interval was seven days and in each occasion the high water level received an equivalent of evapotranspiration for the previous seven days as determined from a class A pan. The latter was located in an agro-meteorogical station about 200m from the experimental site. Amount of water received by the other two watering levels was determined by distance from the sprinkler line. Water application was restricted to calm periods of the day to further minimize wind drift. Catch cans arranged perpendicular to direction of the sprinkler line was used to monitor amount of water applied at each level and this averaged to 217mm for high, 115 for medium and 71 for low.

Cultivation was done to attain appropriate filth and seed drilled at interrow spacing of 60cm. After three weeks the stand was thinned to intra-row spacing of 15cm. Manual weeding was done at regular intervals to keep the field weed free. No other cultural practices were done.

The following parameters were measured:

(i) <u>Leaf water potential</u>

Measurements of mid-day leaf water potential were done on the youngest well exposed and fully expanded leaf on three episodes namely 41, 62, and 95 days after emergence. All the days had clear sunny weather. Three plants were randomly selected per sub-plot and a small disc was obtained from the target leaves of each plant using a 12mm cork borer. The leaf discs were immediately placed in sample chamber of thermocouple psychrometer (Wescor, C-52, Crump Scientific Products U.K) connected to the HR-33T dew point microvoltameter (Wescor Inc. London). The discs were left in the sample chamber for 15 minutes to equilibrate before readings were obtained. Each reading was calibrated to standard temperature (25_C) and then calibrated for chamber differences. The final readings were recorded as leaf water in bars at 25_C.

(ii) Leaf solute potential

Readings of midday leaf solute potential were also obtained from the youngest well exposed and fully expanded leaf on 43, 64 and 78 days after emergence. Once again all the three days had clear and sunny weather. Three plants were used per sub-plot. The leaves were plucked from these plants then squeezed to obtain sap enough to fully wet three standard 12mm discs. Immediately upon soaking the paper discs were placed in sample chamber of the thermocouple psychrometer (Wescor, C-52, Crump Scientific Products Ltd, U.K.). Connected to the HR - 33T dew point microvoltmeter (Wescor INC.) for 15 minutes equilibration, after which the readings were taken. Each reading was then calibrated to $25^{o}C$ and for sample chamber differences before recording the final reading in bars at $25^{o}C$.

(iii) Shoot Biomass

This was determined on 51, 65 and 79 days after emergence. In each occasion, plants falling within 1m stretch in a row were cut at stem base in each sub-plot. Hence an area of $0.6m^2$ was harvested in each sub-plot in each occasion. Biomass samples were only taken from the outer two rows in each sub-plot leaving the inner four for physiological and yield measurements. The cut plants were washed under tap water and dried in oven for 72 hours after which the dry weight was recorded.

(iv) Final Plant Height

This was measured at harvest time on contiguous plants lying within 1m stretch. Two such stretches were used per plot giving an average of 14 plants per sub-plot.

Yield and Yield Components

These were obtained from the same plants used for plant height measurements.

Data for all the parameters were analyzed using ANOVA. Mean separation tests were done using Duncan's multiple range test.

Results and Discussion

In all three occasions low watering level had significantly lower leaf water potential than high and medium (Tables 2.1a, 2.1b, 2.1c) indicating that this parameter was depressed by drought stress. There were, however, no varietal differences. Leaf solute potential showed the same trend (Tables 2.2a,

Table 2.1 (a): Leaf Water Potential (bars) 41 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-14.8	-13.6	-12.7	-13.2	-13.59b
M	-12.9	-12.4	-11.4	-13.2	-12.5 b
H	-10.6	-10.3	-10.3	-10.4	-10.4 a
Varieties Means (ns)	-12.8	-12.1	-11.5	-12.3	-12.2

Table 2.1 (b) 62 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-16.6	-16.9	-17.6	-17.7	-17.1 c
M	-14.4	-15.1	-14.7	-15.2	-14.9 b
H	-11.7	-10.7	-11.8	-9.6	-11.0 a
Varieties Means (ns)	-14.2	-14.2	-14.6	-14.2	-14.3

Table 2.1 (c): 95 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-17.8	-18.4	-19.7	-21.0	-19.2 b
M	-16.4	-17.6	-18.7	-18.3	-17.8 b
H	-12.9	-11.6	-12.8	-11.3	-12.2 a
Varieties Means (ns)	-15.7	-15.9	-17.1	-16.9	-16.4

2.2b, and 2.2c). It is common that total leaf water potential and solute potential decrease with increasing soil water deficits (Turner, 1979; Bradford and Hsiao, 1980) although the effect is sometimes insignificant under field conditions where drought develops gradually (Nyabundi and Hsiao, 1989). That we got highly significant differences between high and low watering treatments indicates that these parameters are sensitive to drought in sesame. Reduced leaf water potential may lead to reduced stomatal conductance and reduced CO_2 flux across the leaf epidemis if it is associated with loss of turgor. On the other hand leaf water potential reduction may arise from increased solute accumulation in cell sap which reduce solute potential. In the latter case, usually referred to as osmotic adjustment, pressure potential may be maintained thus preventing reduction in stomatal conductance. In the case of these sesame varieties, wilting was not observed in the stressed treatments and a study to look at pressure potential, stomatal conductance and photosynthesis is called for.

Table 2.2 Leaf Solute Potential (bars) (a) 43 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-15.3	-15.3	-14.6	-16.1	-15.3 a
M	-13.0	-14.1	-13.9	-13.7	-13.7 b
H	-12.6	-11.7	-12.0	-11.1	-11.9 c
Varieties Means (ns)	-13.6	-13.6	-13.5	-13.6	-13.6

Table 2.2 (b) 65 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-18.3	-16.6	-18.9	-19.5	-18.1 c
M	-14.3	-15.0	-16.6	-16.5	-15.6 b
H	-13.0	-12.4	-12.6	-11.4	-12.2 a
Varieties Means (ns)	-15.2	-14.8	-16.0	-15.4	-15.4

Table 2.2 (c) 78 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	-19.9	-20.8	-20.3	-22.1	-20.8 bc
M	-19.2	-19.1	-18.5	-20.5	-19.3 b
H	-12.8	-13.2	-13.1	-11.3	-12.6 a
Varieties Means (ns)	-17.3	-17.7	-17.3	-18.0	-17.6

Varietal differences in leaf water potential have been reported in soybeans (Cortes and Suiclair, 1986) rice (Novero et al, 1985) and beans (Runkulatile, 1991; Ouma, 1988). That selection based on plant water status can be effective and rapid was demonstrated in field experiments by Meyer and Boyer (1972) and Greacen and Oh (1972). They independently showed that plants can compensate osmotically for the onset of dryness in soils to maintain growth. Similar results were reported by Boyer (1982). Morgan (1977) found that wheat cultivars selected for osmotic adjustment outyielded conventional ones by 100% under dry conditions.

That we did not find any differences in water potential among the sesame varieties may suggest inherent behaviour in this species or a restriction in genetic diversity of the varieties used. A wider study using more varieties will be undertaken in next phase.

Plant height responded significantly to both watering levels and varieties (Table 2.3) and so did biomass (Tables 2.4a, 2.4b, 2.4c). Variety V_1 was significantly taller than V_3 and V_4 and it also had significantly higher biomass. Watering treatments showed a decrease in plant height and biomass with decreasing amounts of applied water. Both plant height and shoot biomass depend on expansive growth of a plant. It has been well demonstrated that expansive growth is the physiological attribute most sensitive to water stress. This phenomenon has been associated with cell turgor and/or cell wall extensibility (Michelena and Boyer 1982; Van Volkenbourgh and Boyer, 1985).

Table 2.3 Plant Height at Maturity

	V_1	V_2	V_3	V_4	WATERING MEANS
L	75.7	67.4	66.7	67.6	69.4 a
M	94.1	89.7	76.4	84.7	86.2 b
H	114.1	107.0	104.7	99.7	106.4 c
Varieties Means (ns)	94.6	88.0	82.6	84.6	87.3

Table 2.4 (a): Biomass (g/plant) on 51 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	8.9	8.7	8.6	8.3	8.6 a
M	14.1	9.4	11.6	9.2	11.1 b
H	18.5	13.4	12.2	13.1	14.3 c
Varieties Means (ns)	13.8	10.5	10.8	10.2	11.3

Table 2.4 (b): Biomass (g/plant) on 65 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	14.3	12.1	11.5	9.9	12.0 a
M	17.4	14.9	14.0	14.6	15.2 b
H	25.8	18.5	22.1	20.1	21.6 c
Varieties Means (ns)	19.2	15.2	15.9	14.9	16.3

Table 2.4 (c): Biomass (g/plant) on 79 DAE

	V_1	V_2	V_3	V_4	WATERING MEANS
L	17.0	13.0	14.6	12.1	14.2 a
M	28.9	25.5	23.8	20.0	24.6 b
H	39.7	29.0	30.7	32.3	2.9 c
Varieties Means (ns)	28.5	22.5	23.0	21.5	23.9

Table 2.5: Relative per cent decrease between High and Low water stress

	V_1	V_2	V_3	V_4	X
Plant Height	33.6	37.1	36.3	32.4	4.0
Biomass at 65 DAE	44.73	34.59	47.80	50.93	44.39
Biomass at 75 DAE	57.11	55.03	52.21	60.83	56.30

Table 2.6 Yield and Yield Components (a) Yield (Kg/ha)

	V_1	V_2	V_3	V_4	WATERING MEANS
L	861.2	745.5	628.0	629.2	716 a
M	1009.2	868.2	764.7	927.1	892.3a
H	1803.3	1466.5	1438.6	1380.6	1522.1b
Varieties Means (ns)	1224.6	1026.7	943.6	979.0	10.43.5

A comparison of relative decrease in plant height and biomass in response to water stress revealed no varietal differences (Table 2.5) suggesting that the varieties were about equally affected by drought irrespective of their differences in actual height and biomass.

Yield and yield components were also affected by water stress. High water level yielded significantly higher than medium and low (Table 2.6). Among the varieties, V_1 outyielded the others.

Number of capsule per plant was significantly lowest in low water treatment followed by medium and high but no varietal differences were observed. The treatments had no significant effect on seeds per capsule but 1000 seed weight was significantly higher in high water level compared to the other two. Among varieties V_1 had significantly highest 1000 seed weight followed by V_2 while V_3 and V_4 were not significantly different with respect to this parameter. Since number of capsules per plant and seeds per capsule were not significantly different among the varieties the fact that V_1

yielded significantly higher than the other varieties can only be associated with the difference in 1000 seed weight. This genetic difference in seed weight should be explored in efforts to select for higher yields.

Table 2.6 (b): Capsule /plant

	V_1	V_2	V_3	V_4	WATERING MEANS
L	42.9	42.7	40.0	40.4	41.5 a
M	71.2	70.7	50.8	69.8	65.6 b
H	110.3	105.5	105.9	107.1	107.2 c
Varieties Means (ns)	74.8	73.0	65.6	72.4	71.4

Table 2.6:(c): Number of Seeds per capsule

	V_1	V_2	V_3	V_4	WATERING MEANS (ns)
L	63.5	61.2	50.7	58.7	58.5
M	63.8	63.9	60.1	60.6	62.1
H	65.5	65.1	64.9	62.7	64.6
Varieties Means (ns)	64.3	63.4	58.6	60.7	61.7

Table 2.6 (d): 1000 Seed weight (grams)

	V_1	V_2	V_3	V_4	WATERING MEANS
L	3.5	2.9	2.4	2.4	2.8 a
M	3.7	2.9	2.3	2.4	2.8 a
H	3.8	3.0	2.7	2.6	3.0 c
Varieties Means (ns)	3.7	2.9	2.5	2.5	2.9

Literature cited

1. Ayiecho, P.O.; J.O. Nyabundi and K.W. Nyabundi. 1991. Sesame (Kenya) project. First Technical report. International Development Research Centre, Ottawa, Canada.
2. Boyer J.S. 1982. Plant productivity and environment. Science 218: 443 - 8.
3. Bradford K.J. and T.C. Hsiao. 1982. Physiological responses to moderate water stress. In. O.L. Lange, P.S. Nobel, C.B. Osmond and H. Zeigler (Eds.) Encyclopidea of plant physiology, New Series, Vol. 12B. Springer - Verlag, New York. pp. 263 - 324.
4. Cortes P.M. and T.R. Sinclair. 1986. Water relations of field-grown soybean under drought. Crop. Sci. 26: 993 - 8.
5. Greacen, E.L. and J.S. Oh. 1972. Physics of root growth. Nature. 235: 24 - 5.

6. Hall, A.E. and D.M. Yernomas. 1975. Leaf conductance and water status of sesame strains in hot dry climates. Crop Sci. 15: 789 - 93.

7. Meyer R.F. and J.S. Boyer. 1972. Sensitivity of cell elongation to low water potential in soybean hypocotyls. Planta. 108: 77 - 87.

8. Morgan, J.M. 1977. Differences in osmoregulation between wheat genotypes. Nature 270: 234 - 5.

9. Michelena, V. A. and J.S. Boyer. 1982. Complete turgor maintenance at low water potentials in the elongating region of maize leaves. Plant Physiol. 69: 1145 - 1149.

10. Novero R.P., J.C. O'Toole, R.T. Cruiz and D.P. Garrity. 1985. Leaf water potential, crop growth response and microclimate of dryland rice under line-source sprinkler irrigation. Agric. For. Meterol. 35: 71 - 85.

11. Nyabundi, J.O. and T.C. Hsiao. 1989. Effect of water on growth and yield of field-grown tomatoes. I. Canopy development and biomass accumulation E. Afri. Agric. For. J. 55:

12. Ouma J.P. 1988. Effect of soil moisture deficit on photosynthesis and leaf water potential of field-grown beans. M.SC. Thesis. Univ. of Nairobi, Nairobi, Kenya. 1988.

13. Runkultile, H.H.E. 1991. A study of physiological and ecological adaptation of common beans to drought stress. M.Sc. thesis. Univ. of Nairobi, Nairobi, Kenya. 1991.

14. Turner, N.C. 1979. Drought resistance and adaptation to water deficits in crop plants. In. H. Mussel and R.C. Staples (eds.) Stress physiology in crop plants Wiley Interscience New York.

15. Van Volkenbourgh, E. and J.S. Boyer. 1985. Inhibitory effects of water deficits on maize elongation. Plant Physiol. 77: 190 - 4.

4.2. GERMPLASM ACQUISITION AND VARIETAL DEVELOPMENT.

4.2.1. Objectives

(i) Develop sesame germplasm bank by assembling germplasm from national and international sources and conduct botanical studies to catalogue the assembled germplasm.

(ii) Develop varieties with desirable traits for Coast Province.

4.2.2. Germplasm acquisition

4.2.2.1 Materials and Methods

Trips were made to trading centres and farmers in Coast, Nyanza and Western provinces to collect the local germplasm. Efforts were made to ensure that sesame seed collection was not repeated in areas already visited in the first year of the project.

4.2.2.2. Results

Twenty more germplasm accessions (Table 4.2.1) were added to the previously acquired collection. These newly acquired germplasm materials are currently grown for seed multiplication and botanical studies at Mtwapa.

Table 4.2.1.: Germplasm acquired in 1991 and 1992

SIK No.	Accession	Country of origin
113	Landrace (local)	Kenya
115		Tanzania
116	Landrace (local)	Kenya
117	Landrace (local)	Kenya
118	Yuzhi No.1	China
119	Yuzhi No.2	China
120	Yuzhi No.4	China
121	Yuzhi No.5	China
122	Qingfeng	China
123	Nanyang	China
124	Deng Xian	China
125	Yiexian	China
126	Luyi	China
127	Huojia	China
128	Ji-Zhi- No.1	China
129	Ji-Zhi- No.2	China
130	Ji-Zhi- No.3	China
131	Bei-Zhi- No.1	China
132	Beijing 0003	China
133	Terras 77	Kenya
134	Pachequeno	Kenya

4.2.3 Germplasm screening for varietal development

4.2.3.1 Materials and Methods

The acquired germplasm were subjected to preliminary evaluations during the long rains of 1991 and long rains of 1992 at Mtwapa. The accessions were planted in two replicate randomised complete designs. Each accession was planted in a plot of 2 rows in each replicate. The spacing between the rows was 50 cm while within row spacing was 20cm. Data was taken on a total of 10 plants in each plot for plant height, number of capsule bearing branches per plant, height of first capsule height of first capsule bearing branch, stem length from first capsule to tip, number of capsules per plant, days to flowering and seed yield per plant. Plants were observed for incidence of pest and disease attack, lack of lodging and vigour.

4.2.3.2. Results

Field screening experiments during the growing season of 1991 indicate that the germplasm accessions were of medium height, with an average height of 70.5 cm (Table 4.2.2). The local landraces were generally taller. The degree of branching

Table 4.2.2:
Mean performances of the sesame germplasm accessions at Mtwapa, 1991.

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
001	Landrace	90.0	4.0	28.4	50.9	39.5	49.0	63.0	14.5
002	"	82.8	5.0	26.3	48.1	34.6	43.0	55.0	13.0
Black									
002	"	70.6	3.0	32.4	46.8	23.8	21.0	61.0	13.0
003	"	73.6	3.0	20.7	39.1	43.5	40.0	61.0	17.0
004	"	78.5	4.0	23.5	45.4	33.1	41.0	56.0	7.7
005	"	79.4	4.0	20.9	44.0	35.3	50.0	61.0	9.1
006	"	70.6	4.0	22.3	47.2	23.3	27.0	62.0	15.0
007	"	84.5	3.0	24.5	46.2	38.3	42.0	61.0	6.3
008	"	83.0	4.0	24.6	48.4	34.5	33.0	63.0	9.6
009	"	91.7	5.0	18.8	45.2	46.5	70.0	61.0	11.8
010	"	86.5	6.0	21.0	49.5	37.0	64.0	61.0	7.9
011	"	77.3	4.0	25.1	44.5	32.7	42.0	57.0	6.5
012	"	78.7	5.0	22.5	47.0	31.6	44.0	61.0	8.9
013	"	75.5	4.0	24.0	47.0	28.4	30.0	62.0	6.6
014	"	76.5	4.0	30.1	55.0	21.5	36.0	62.0	9.1
015	"	85.6	5.0	26.1	57.1	28.5	44.4	62.0	8.9
016	"	86.6	4.0	38.6	56.0	30.6	32.0	62.0	13.1
017	"	81.0	6.0	27.1	54.3	26.6	35.0	63.0	15.0
018	"	81.5	4.0	36.9	58.6	22.8	27.0	63.0	6.0
019	"	78.7	4.0	23.4	45.0	33.7	29.0	61.0	6.2
020	"	98.1	5.0	36.0	60.6	37.4	41.0	62.0	9.0
024	"	72.9	4.0	0.1	45.0	27.9	25.0	62.0	6.4
025	SS 14	51.7	2.0	14.0	26.6	25.0	19.0	54.0	11.5
026	SS 23	65.1	3.0	8.2	27.3	37.8	38.0	46.0	7.3
027	E	74.9	2.0	28.4	43.6	31.3	30.0	61.0	8.9
028	MUB 0010	69.9	5.0	23.6	43.1	26.8	31.0	61.0	5.0
029	BAR 0002	62.5	4.0	22.7	34.1	28.3	18.0	62.0	3.5
030	SPS 1115-15	84.0	4.0	28.4	46.0	38.0	34.0	61.0	4.3
031	CLSU 5	59.6	4.0	24.5	34.3	25.3	21.0	62.0	5.1
032	AW 0007	80.9	4.0	31.4	45.1	35.7	33.0	63.0	4.7
033	SPS.B/M52	91.4	6.0	31.9	61.8	29.6	44.0	62.0	7.7
034	4LOCULE WHITE 0075	78.6	5.0	20.3	43.4	35.2	44.0	62.0	3.0
035	4LOCULE WHITE 0034	81.0	4.0	30.9	49.6	31.3	31.0	61.0	7.5
036	BAR 0004	81.8	5.0	29.5	51.5	29.3	39.0	61.0	5.5

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
037	4LOCULE REDDISH	73.3	4.0	32.4	41.8	31.4	25.0	62.0	4.0
038	LOCAL BLACK	77.3	3.0	37.8	54.5	22.8	23.3	63.0	4.5
039	T 85	62.1	3.0	11.6	31.1	31.0	32.0	44.0	6.9
040	CARIPUCHAX TYP. DET	62.6	3.0	19.6	31.1	31.5	31.0	49.0	12.0
042	8-LOCULE BLACK	74.0	3.0	24.3	44.0	29.9	33.0	61.0	12.2
043	8-LOCULE WHITE	85.7	5.0	29.9	53.5	32.2	23.O	62.0	2.6
044	COL-BORAGO TYP.DET.	57.8	3.0	15.4	29.0	28.8	29.0	51.0	13.0
045	CLSU 8	80.3	3.0	24.4	41.5	38.8	40.5	61.0	8.9
046	SADUTALA 102	73.4	4.0	17.5	32.1	41.3	43.0	53.0	7.1
047	CLSU 39	66.9	3.0	20.3	34.5	32.3	23.0	50.0	6.6
048	SUWEON 21X TYP. DET.	64.3	4.0	21.1	39.1	25.1	25.0	43.0	7.0
049	MMY 0031	66.3	3.0	24.5	1.0	25.2	21.0	62.0	13.0
050	CLSU 9	69.1	4.0	29.0	47.3	21.7	26.0	61.0	11.5
051	LOCAL 78	74.3	4.0	31.4	51.4	22.9	24.0	62.0	5.0
052	MI 2	78.5	4.0	28.6	28.8	49.7	39.0	61.0	4.1
053	CLSU 26	79.8	4.0	25.2	47.1	32.7	30.0	60.0	11.8
054	MI 3	53.0	2.0	18.3	24.0	29.0	18.0	46.0	18.5
055	H-38-2	66.4	3.0	17.8	32.1	34.3	33.0	45.0	6.1
056	UCR82-2 TYP.DET	49.1	2.0	13.7	22.8	26.2	15.0	44.0	10.5
057	CLSU 14	82.8	3.0	41.3	58.5	24.3	16.0	63.0	7.0
058	CLSU 4	73.0	4.0	29.5	40.3	32.6	17.0	61.0	20.0
060	GIZR 25	45.5	2.0	18.7	26.8	18.6	11.0	53.0	28.4
061	CLSU	69.7	3.0	25.3	43.2	26.5	21.0	63.0	5.7
062	LOCAL 158	52.3	3.0	11.8	25.9	26.4	15.0	48.0	10.3
063	CLSU 60	65.6	4.0	24.7	43.2	22.4	22.0	63.0	6.6
064	CLSU 64	63.0	4.0	18.4	22.9	40.0	14.0	54.0	15.1
065	B IO	77.1	3.0	26.0	43.7	33.3	25.0	43.0	9.1
066	LOCAL 185	58.0	3.0	19.3	29.0	29.0	22.1	46.0	5.5
067	MALGO SHORT TYP.DET	42.3	2.0	23.8	31.6	10.7	16.0	46.0	13.0
068	GIZA 32	65.9	3.0	17.5	24.8	41.1	19.0	45.0	24.0

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
069	EVA X TYP.DET	63.1	3.0	20.2	32.6	30.5	21.0	57.0	12.02
070	H-60-30-11	65.6	3.0	18.3	32.3	33.3	24.0	49.0	4.7
071	T6	56.5	3.0	22.8	33.3	23.1	24.0	42.0	9.0
073	TMV5	65.5	3.0	30.8	38.5	27.0	18.0	62.0	8.8
077	TANU22	61.8	4.0	23.6	38.8	23.O	31.0	61.0	7.2
078	TANU 28	67.9	4.0	18.4	38.1	29.8	42.0	61.0	13.5
080	FAO.68.541	74.5	4.0	31.5	45.5	28.9	26.0	60.0	6.8
081	FAO.68.542	85.2	4.0	32.0	50.6	34.6	36.0	64.0	11.2
082	FAO.68.543	65.5	3.0	21.4	37.2	28.3	25.0	61.0	4.9
083	FAO.68.544	65.4	3.0	28.2	43.8	21 .6	11.0	61.0	14.2
084	FAO.68.548	63.0	3.0	24.7	34.5	28.5	18.0	61.0	5.0
085	BORA	62.5	3.0	24.4	38.3	26.8	21.0	63.0	11.0
086	SSBS.9(2)	67.3	3.0	35.7	50.1	17.2	11.0	62.0	7.0
087	NAL 79-1	66.1	4.0	24.1	47.9	18.1	33.0	61.0	13.2
088	NAL-79-111-9	72.3	3.0	32.8	49.0	23.3	73.0	62.0	6.2
090	28-249-2-(4)	72.8	4.0	32.2	47.7	25.0	18.0	63.0	14.4
091	B1	66.1	3.0	11.9	25.5	40.5	34.0	53.0	4.5
092	B2	61.2	3.0	17.8	36.2	25.0	16.0	62.0	9.1
093	B3	66.6	6.0	13.9	30.9	35.6	32.0	54.0	11.0
094	B4	64.1	4.0	19.2	34.5	29.5	25.0	61.0	13.2
095	B5	71.8	5.0	17.5	28.6	43.1	23.0	46.0	8.9
096	B6	75.6	3.0	32.3	44.5	31.1	16.0	53.0	27.6
097	C1	73.3	3.0	22.1	34.1	39.1	28.0	60.0	16.2
098	C2	77.6	4.0	26.5	46.1	31.5	31.0	48.0	6.1
099	C3	69.5	3.0	30.7	40.5	28.9	21.0	54.0	8.2
100	C4	52.6	2.0	17.4	30.3	22.3	9.0	62.0	7.8
101	CN-1	66.6	3.0	25.6	34.1	32.5	16.0	61.0	11.4
102	CN-2	65.4	3.0	34.4	45.9	19.5	13.0	63.0	7.5
103	LOCAL 199	64.0	3.0	17.1	35.0	29.0	34.0	61.0	6.5
104	ZHULTS-X TYP-DET	53.0	2.0	20.0	31.0	22.0	16.0	48.0	9.2
105	CLSU 1	84.8	4.0	33.2	60.8	24.0	24.0	62.0	8.2
106	LOCAL180	75.1	4.0	17.3	36.8	38.3	37.0	51.0	5.8
107	NCS 111	69.0	4.0	20.3	33.0	35.9	37.0	62.0	9.3
108	ZHULT S.XPUNG XZHULT S	61.0	3.0	10.9	26.7	34.2	30.0	48.0	4.4
109	UCR82 -2X	64.3	3.0	18.3	35.7	28.6	27.0	44.0	9.7
MEAN		70.5	4.0	24.3	40.9	30.1	29.0	57.0	9.5
SD		11.4	0.9	6.7	9.58	6.6	11.9	6.5	4.76

varied between 2 and 6. The most branched accessions were SIK 010, SIK 017, and SPS.B/M52. On average capsule production was restricted to less than _ of the plant height. Some accessions like SIK 006, SIK 002 Black, and SIK 014 had capsule production restricted to less than a third of the shoot length. Capsule production varied between 11 capsules per plant and 73 capsules per plant. The highest capsule number was obtained from SIK 009 and NAL 79.111.9. The average days to flowering was 57. The earliest flowering accession was T6 which took 42 days to set flowers. While the latest was FAO 68.542 (64 days). Most of the accessions needed at least 60 days to flower. Average seed yield was 9.5g per plant. The highest yielding accessions were SIK 001, SIK 003, SIK 006, MI3, CLSU4, Giza 25, CLSU 64, Giza 32, 28-249-2-2(4), FAO 68.544, B6 and C1.

The data from experiments conducted during the long rains of 1992 are presented in Table 4.2.3. The plants had an average height of 71.6cm. The tallest accessions were SIK 006, SIK 009, SIK 016, 28-249-2-2(4) and CN2 while the shortest cultivars was B1O. All the cultivars were branched with the most branched being SIK 015, SIK 016, SIK 024, MUB 00100, AW 0007, 4-Locule White 0034, Bar 0004, Local 78, CLSU 14, CLSU 3, Evax TYp.Det. C2, CN 2, Co 1 and TANU 28. On the average the cultivars had about _ of the shoot length having capsules. However some cultivars had fairly low number of capsule per plant e.g. SIK 008, SIK 018, SIK 020, SS 14, CLSU 5,

Table 4.2.3. Mean performances of the sesame germplasm accessions at Mtwapa in 1992.

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
001	Landrace	79.8	4.0	16.0	39.2	40.5	34.0	55.0	11.0
002	"	82.1	3.0	21.3	41.7	40.4	44.0	55.0	15.0
002 Black	"	87.6	5.0	23.8	49.2	38.5	42.0	56.0	9.0
003	"	95.8	4.0	20.5	45.4	50.4	50.0	54.0	20.0
004	"	88.2	4.0	21.5	46.1	42.1	48.0	55.0	15.0
005	"	86.3	5.0	14.6	36.8	49.4	46.0	53.0	11.0
006	"	102.1	5.0	15.6	43.5	58.6	64.0	54.0	16.0
007	"	79.3	2.0	16.3	28.8	50.5	35.0	54.0	10.0
008	"	68.3	3.0	17.1	33.4	34.8	22.1	57.0	6.2
009	"	96.9	4.0	19.6	44.3	52.6	66.0	54.0	8.0
010	"	81.6	3.0	15.8	37.4	44.3	35.0	54.0	13.0
011	"	79.9	4.0	18.9	38.4	41.4	31.0	56.0	17.0
012	"	70.9	4.0	16.9	35.2	35.6	32.0	56.0	15.0
013	"	66.9	4.0	14.6	32.3	34.5	27.0	57.0	7.0
014	"	64.5	4.0	20.8	40.9	23.5	17.0	55.0	14.5
015	"	85.9	5.0	19.9	46.9	38.9	41.0	55.0	16.1
016	"	90.5	6.0	25.9	57.9	32.6	31.0	58.0	7.4
017	"	89.1	4.0	21.4	44.5	44.5	38.0	57.0	6.1
018	"	64.9	4.0	18.9	39.5	25.4	22.4	58.0	9.2
019	"	82.3	4.0	16.1	38.2	50.1	43.0	55.0	6.1
020	"	56.3	4.0	15.4	34.6	21.6	17.0	57.0	10.2
024	"	76.7	6.0	17.0	44.0	32.6	34.0	58.0	8.1
025	SS 14	72.3	4.0	20.8	30.3	41.9	5.0	51.0	1.3
026	SS 23	59.4	3.0	8.4	21.0	38.4	23.0	50.0	9.4
027	E	68.4	4.0	17.7	37.5	30.9	27.5	58.0	13.1
028	MUB 0010	71.5	5.0	18.6	42.9	28.6	37.0	57.0	33.0
029	BAR 0002	72.4	4.0	13.4	35.4	35.4	23.0	55.0	6.2
030	SPS. 1115-15	77.0	4.0	19.9	43.3	34.0	35.0	57.0	7.3
031	CLSU 5	51.4	3.0	13.6	21.8	29.5	21.0	54.1	6.1
032	AW 0007	78.8	6.0	17.1	42.7	6.1	27.0	57.0	9.2
033	SPS.B/M52	65.3	3.0	18.0	38.3	27.0	19.0	56.0	10.7
034	4LOCULE WHITE 0075	75.4	4.0	19.1	41.6	33.7	30.0	56.0	6.7
035	4LOCULE WHITE 0034	78.7	5.0	16.8	41.9	36.8	31.0	55.0	21.0
036	BAR 0004	63.3	6.0	14.9	40.8	22.4	23.0	57.0	8.7
037	4LOCULE REDDISH	50.7	4.0	18.4	38.5	12.2	23.0	56.0	2.5
038	LOCAL								

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
	BLACK	77.8	4.0	22.1	44.6	33.1	25.0	57.0	5.8
039	T 85	56.0	3.0	14.5	24.7	31.2	12.0	52.0	5.0
040	CARIPUCHAX TYP. DET	71.3	3.0	50.8	26.7	44.5	34.0	47.0	10.6
042	8-LOCULE BLACK	61.5	4.0	17.2	34.3	27.1	19.0	59.0	15.6
043	8-LOCULE WHITE	64.5	4.0	14.2	31.9	32.5	20.O	56.0	5.7
044	COL-BORAGO TYP.DET.	64.2	4.0	12.8	26.8	37.4	31.0	52.0	10.1
045	CLSU 8	64.1	4.0	19.9	30.4	33.7	24.0	55.0	11.1
046	SADUTALA 02	44.1	3.0	9.2	20.1	23.9	15.0	56.0	6.0
047	CLSU 39	57.7	4.0	13.7	32.7	43.0	34.0	54.0	16.6
048	SUWEON 21X TYP.DET.	59.0	3.0	13.2	31.5	27.4	15.0	53.0	6.5
049	MMY 0031	87.5	5.0	15.8	36.6	50.9	42.0	53.0	15.0
050	CLSU 9	71.0	4.0	16.2	36.1	34.8	29.0	56.0	8.9
051	LOCAL 78	91.4	5.0	21.8	53.6	37.7	39.0	55.0	13.0
052	MI 2	52.3	3.0	13.5	23.2	29.1	14.0	54.0	6.3
053	CLSU 26	69.0	4.0	15.4	33.8	35.1	45.0	56.0	14.3
054	MI 3	78.8	4.0	9.3	28.1	50.6	49.0	49.0	14.2
055	H-38-2	68.9	4.0	8.2	24.2	44.6	42.0	51.0	19.0
056	UCR82-2 TYP.DET	63.6	3.0	16.6	30.0	33.5	23.0	54.0	7.9
057	CLSU 14	77.8	5.0	15.5	46.8	31.0	29.0	55.0	11.5
058	CLSU	66.6	4.0	13.4	29.6	36.9	21.8	55.1	20.0
060	GIZA 25	74.7	3.0	16.1	32.0	42.7	39.0	56.0	27.7
061	CLSU 3	67.3	5.0	15.5	34.1	33.1	32.0	54.0	37.0
062	LOCAL 158	61.5	4.0	11.7	31.8	29.7	24.0	55.0	9.3
063	CLSU 60	67.2	2.0	14.1	24.5	42.7	19.0	54.0	9.0
064	CLSU 64	58.0	3.0	1.0	29.2	28.7	31.0	51.0	12.0
065	B 1O	39.7	4.0	11.7	22.1	17.6	7.0	54.0	1.9
066	LOCAL 185	45.4	4.0	13.8	26.3	19.1	15.0	56.0	4.0
067	MALGO SHORT TYP.DET.	51.5	2.0	9.5	20.5	30.9	26.0	49.0	13.0
068	GIZA 32	60.2	5.0	13.2	37.7	22.4	19.0	52.0	21.0
069	EVA X TYP.DET	84.1	3.0	14.1	39.3	44.8	53.0	53.0	16.7

SIK No.	ACCESSION	Plant height (cm)	No. of branches per plant	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule to tip (cm)	No. of capsule per plant	No. of days to flower	Seed yield per plant (g)
070	H-60-30-11	72.3	3.0	15.9	43.5	28.8	29.7	50.0	7.3
071	T6	35.9	2.0	10.8	21.0	14.8	15.0	54.0	13.5
073	TMV5	80.8	4.0	15.1	35.0	45.8	39.0	54.0	15.4
077	TANU 22	81.5	4.0	19.7	36.7	44.8	49.0	55.0	17.9
078	TANU 28	82.5	5.0	13.7	39.5	43.0	47.0	56.0	19.5
079	CO 1	74.4	5.0	17.3	40.5	33.9	32.0	58.0	13.3
080	FAO.68.541	72.2	4.0	18.2	39.0	33.6	22.0	56.0	8.7
081	FAO.68.542	73.3	3.0	15.7	45.0	27.6	27.0	54.0	7.3
082	FAO.68.543	58.1	2.0	15.3	22.3	35.8	17.0	54.0	6.0
083	FAO.68.544	84.2	4.0	22.2	47.3	36.8	30.0	55.0	17.8
084	FAO.68.548	82.0	4.0	13.9	29.0	50.9	38.0	53.0	14.9
085	BORA	86.1	4.0	17.7	41.6	44.4	31.0	54.0	14.0
086	SSBS.9(2)	89.4	4.0	20.8	47.6	41.7	35.0	55.0	11.2
087	NAL 79-1	81.4	4.0	20.1	37.5	43.8	29.0	56.0	12.0
088	NAL-79-111-9	74.7	3.0	15.9	35.5	39.1	27.0	54.0	7.7
090	28-249-2-4)	99.3	6.0	20.2	52.2	47.1	44.0	55.0	19.4
091	B1	66.4	3.0	15.1	25.6	40.8	26.0	54.0	7.2
092	B2	67.6	4.0	14.9	29.9	37.6	27.0	55.0	13.0
093	B3	63.8	2.0	12.1	26.6	37.1	26.0	52.0	9.1
094	B4	75.0	4.0	14.6	34.6	40.3	36.0	55.0	14.0
095	B5	53.1	3.0	10.2	18.6	34.5	13.9	47.0	10.7
096	B6	84.0	4.0	14.7	35.6	48.3	40.0	49.0	15.8
097	C1	56.6	3.0	17.0	27.4	29.1	16.0	56.0	10.0
098	C2	77.1	5.0	18.2	4.9	72.2	29.0	56.0	12.4
099	C3	55.9	2.0	11.9	22.3	33.5	26.0	48.0	16.1
100	C4	82.3	4.0	18.1	33.3	48.9	36.0	54.0	10.9
101	CN-1	57.5	3.0	13.5	24.9	32.6	23.0	54.0	6.4
102	CN-2	103.9	5.0	29.7	48.2	55.6	36.0	57.0	15.6
103	LOCAL 199	68.1	2.0	9.0	21.6	46.5	29.0	52.0	13.4
104	ZHULTS-X TYP-DET	61.3	3.0	11.5	25.3	36.0	26.0	48.0	9.2
105	CLSU 1	59.2	3.0	13.7	27.3	31.8	24.0	53.0	6.5
106	LOCAL180	62.2	4.0	12.2	26.7	35.6	23.0	52.0	3.9
107	NCS 111	81.0	3.0	13.5	28.7	52.2	41.0	53.0	19.8
108	ZHULT S.XPUNG XZHULT S.	54.4	3.0	11.8	23.2	31.2	27.0	49.0	15.9
109	UCR82 -2X	64.4	4.0	12.0	26.3	38.0	28.0	50.0	14.0
MEAN		71.6	4.0	16.3	34.4	37.1	0.0	54.0	12.0
SD		13.5	0.95	5.2	9.1	9.7	11.2	2.6	5.89

SPS.B/M52, 8-Locule Black, Suweon 21X Typ.Det, MI2, T6 and Local 185. On the other hand SIK 003, SIK 006, MI3, Éva-XTyp.Det and TANU 22 had high number of capsules. The plants flowered earlier than they did in 1991. The average days to flower was 54. The earliest accessions were MI3, H.60.30.11, B5, B6, C3, Zhult S.X Typ.Det. and Zhult S.X. Pung X Zhult S. while the latest were SIK 016, SIK 018, SIk 024, E, 8 Locule Black and Co1. The highest seed yields were obtained from SIK 003, MUB 0010, 4.Locule White 0034, CLSU 4, Giza 25, CLSU 3 and Giza 32.

Based on vigour, capsule production, seed yield, lack of lodging, lack of disease infection and pest attack during the three seasons of study (1990, 1991 and 1992) promising cultivars were selected for further testing. Among the accessions listed in Tables 4.2.2 and 4.2.3 only 67 have been selected for further tests. These are enlisted in Table 4.2.4.

Table 4.2.4.: Promising germplasm accessions selected for further tests.

SIK No.	Accession
001	Landrace (local)
002	" "
002 Black	" "
003	" "
004	" "
005	" "
006	" "
010	" "
011	" "
012	" "
013	" "
014	" "
015	" "
016	" "
017	" "

SIK No.	Accession
018	" "
019	" "
020	" "
025	SS 14
027	E
028	MUB 0010
030	SPS. 1115 - 15
031	CLSU 5
034	4 - Locule White 0075
035	4 - Locule White 0034
036	Bar 0004
037	4 locule Reddish
039	T 85
040	Caripucha x Typ.Det
042	8-locule Black
045	CLSU 8
046	Sadutala 102
047	CLSU 39
049	MMY 0031
051	Local 78
052	MI 2
053	CLSU 26
054	MI 3
056	UCR 82 - 2 X Typ. Det
057	CLSU 14
058	CLSU 4
060	Giza 25
065	B 10
069	Eva x Typ.Det
071	T6
073	TMV 5
078	TANU 28
079	Co 1
083	FAO 68.544
084	FAO 68.548
085	Bora
086	SSBS. 9(2)

SIK No.	Accession
087	NAL.79-1
088	NAL.79-111-9
090	28-249-2-2(4)
092	B 2
094	B 4
095	B 5
096	B 6
098	C 2
099	C 3
102	CN 2
103	Local 199
105	CLSU 1
107	NCS 111
108	Zhult-S.xPung x Zhults
109	UCR 82 - 2 X.

4.2.4 Single plant selection tests for varietal development.

4.2.4.1 Materials and Methods

Single plant selection had been initiated on promising accessions in 1990 at Mtwapa. Selection was based on vigour, prolificacy in terms of production of well filled capsules, lack of lodging and lack of pest and disease attack. A total of 123 single plant selections were obtained. These were planted for seed multiplication and visual assessment in 1991. The single plant lines that were noted to be vigourous, had low disease and pest incidence and no lodging were planted for evaluation at Mtwapa during the long rains of 1992. A total of 96 such promising line selections were planted in a two replicate, randomised complete block design. Each line was planted in a two-row plot. Data was taken on a total of 10 plants per plot plant height, number of capsule bearing branches per plant, height of first capsule bearing branch, height of first capsule, stem length from first capsule to tip, number of capsules per plant, days to flowering and seed yield per plant. Plants were also observed for incidence of pest and disease attack, lack of lodging and vigour.

4.2.4.2. Results

The results of pureline selection tests at Mtwapa during the cropping season of 1992 are presented in Table 4.2.5.

Table 4.2.5.: Mean performances of sesame line selections at Mtwapa in 1992.

SIK No.	Plant height (cm)	No. of branches	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule (cm)	No. of capsule	Flower days	Seed yield (g)
SZ 1	63.0	3.0	27.6	35.1	27.8	29.0	65.0	8.3
SZ 2	76.1	4.0	24.5	35.1	40.9	54.0	65.0	7.7
SZ 3	77.6	4.0	23.5	39.6	38.0	30.0	65.0	11.2
SZ 4	80.6	5.0	24.0	47.1	33.5	54.0	64.0	6.3
001	90.7	6.0	25.6	47.0	43.7	53.0	63.0	10.5
003	95.8	8.0	15.6	44.2	51.6	101.0	62.0	11.5
004	46.6	2.0	9.4	17.0	29.6	18.0	45.0	10.5
004X	77.0	4.0	27.5	37.5	39.5	63.0	67.0	7.2
005	64.3	2.0	29.5	37.1	27.2	20.0	67.0	7.7
006	78.1	3.0	28.0	39.5	39.6	40.0	64.0	9.7
007	83.6	5.0	22.1	40.2	43.3	61.0	65.0	17.0
008	58.0	1.0	14.2	24.3	33.6	26.0	60.0	4.5
009	79.2	3.0	26.7	42.0	37.2	21.0	65.0	1.0
010(1)	60.0	2.0	24.8	32.7	27.2	18.0	65.0	9.2
010(2)	85.6	3.0	46.0	60.7	24.8	12.0	62.0	6.1
011	33.2	1.0	4.0	9.4	23.8	13.0	64.0	4.7
012	61.3	2.0	25.3	35.5	25.8	17.0	64.0	7.4
013	87.6	6.0	17.2	62.1	25.5	71.0	61.0	18.0
014	79.1	2.0	28.6	37.5	41.5	22.0	65.0	7.9
016	57.1	2.0	10.5	18.2	38.8	28.0	47.0	13.2
019	81.8	4.0	20.3	42.0	39.8	47.0	66.0	4.4
021	94.5	4.0	26.6	44.2	50.2	48.0	60.0	10.5
023	81.5	5.0	20.8	49.1	32.6	65.0	62.0	4.4
024	89.0	6.0	13.5	44.7	44.2	77.0	63.0	5.2
025	90.8	4.0	22.5	57.8	33.0	58.0	64.0	27.5
026	83.7	6.0	17.5	47.8	35.8	58.0	67.0	14.6
028	90.0	8.0	15.5	54.0	36.0	72.0	62.0	17.8
029	55.1	2.0	17.1	25.7	29.3	19.0	65.0	11.6
030	93.7	4.0	28.6	44.6	49.1	59.0	66.0	7.0
031	87.1	4.0	28.0	48.6	38.5	52.0	62.0	3.6
033	70.0	5.0	18.5	54.0	16.0	38.0	66.0	13.0
034	72.8	4.0	23.7	42.0	30.8	43.0	63.0	7.0
035	91.6	4.0	25.8	43.8	47.7	64.0	62.0	13.0
036	72.5	3.0	20.1	35.8	36.6	37.0	64.0	4.5
038	68.2	4.0	28.5	49.6	18.6	35.0	63.0	7.3
039	65.7	4.0	19.4	34.6	31.1	22.0	63.0	8.5
045	71.8	3.0	29.5	34.7	37.1	20.0	66.0	14.0
046	73.3	4.0	29.5	46.5	26.8	37.0	65.0	20.0
047	86.1	5.0	26.5	43.7	42.3	51.0	62.0	8.1
048	80.6	3.0	33.0	42.1	38.5	32.0	67.0	9.0
049	76.6	4.0	24.1	50.1	26.5	25.0	60.0	14.5
050	64.2	2.0	25.8	34.5	29.7	14.0	60.0	6.7
051	74.1	3.0	25.3	35.2	38.8	40.0	62.0	13.0
055	82.3	4.0	18.5	39.7	42.6	55.0	64.0	3.4
070	91.0	5.0	29.8	56.2	34.7	41.0	63.0	14.2
071	59.5	3.0	19.7	42.0	17.5	10.0	61.0	9.9
072	56.0	0.0	0.0	27.0	29.0	13.0	46.0	11.4
073	46.2	3.0	8.8	21.0	25.2	14.0	65.0	13.0
074	49.0	2.0	20.3	25.3	23.6	14.0	64.0	3.0

SIK No.	Plant height (cm)	No. of branches	Height to first branch (cm)	Height to first capsule (cm)	Stem length from first capsule (cm)	No. of capsule	Flower days	Seed yield (g)
075	72.3	2.0	11.6	25.3	47.0	25.0	63.0	8.6
075`0'	55.7	2.0	17.0	23.7	32.0	24.0	45.0	7.6
076	47.6	1.0	17.2	23.0	24.6	11.0	45.0	5.2
077	59.7	3.0	16.8	23.1	36.6	21.0	65.0	5.1
078	52.5	2.0	11.8	20.6	31.8	30.0	45.0	19.0
079	67.6	2.0	16.8	25.6	42.0	25.0	60.0	9.9
080	90.5	6.0	15.5	56.3	34.1	67.0	63.0	8.5
081	71.2	5.0	26.5	46.7	24.5	32.0	64.0	15.0
082	66.2	4.0	23.0	36.6	29.6	32.0	62.0	18.2
083	57.6	2.0	16.3	23.0	34.6	38.0	59.0	6.2
084	53.2	3.0	12.1	23.7	29.5	29.0	64.0	10.3
085	51.8	2.0	34.0	32.8	19.0	22.0	45.0	16.0
087	78.8	3.0	26.0	36.3	42.5	37.0	62.0	7.4
088	78.2	3.0	21.2	37.8	40.3	74.0	60.0	10.7
089	61.2	3.0	25.0	36.1	25.1	20.1	62.0	8.8
090	57.0	3.0	25.1	38.6	18.3	24.0	65.0	9.0
091	73.5	2.0	21.1	28.5	45.0	33.0	61.0	17.9
092	76.2	2.0	21.6	22.8	53.4	20.0	60.0	9.1
093	62.0	2.0	13.0	24.8	37.1	28.0	43.1	16.5
094	59.1	2.0	21.6	29.3	29.7	18.0	62.0	8.1
096	71.6	3.3	14.6	29.8	41.7	42.0	45.0	17.0
096(2)	81.2	5.0	18.1	37.2	44.0	53.0	62.0	7.9
097(1)	87.3	5.0	25.8	43.0	44.3	51.0	62.0	6.0
097(2)	50.8	3.0	20.3	31.7	19.1	27.0	61.0	11.2
098	104.6	5.0	23.2	50.5	54.1	69.0	61.0	16.0
098K	43.7	2.0	12.2	21.1	22.6	21.8	60.0	15.0
099	64.7	2.0	30.7	41.0	23.7	16.0	67.0	16.9
100	69.2	3.0	25.3	36.5	32.7	32.0	66.0	8.1
101	56.1	2.0	18.7	28.8	27.2	19.0	59.0	7.0
102	72.2	4.0	34.0	52.3	19.8	25.0	68.0	18.0
103	88.8	4.0	32.6	46.6	42.2	56.0	64.0	8.7
106	60.0	2.0	23.7	31.7	28.2	24.0	63.0	6.8
107	82.0	3.0	24.0	37.8	44.1	32.0	46.0	9.3
108	75.2	3.0	22.7	38.0	37.2	23.0	63.0	9.3
110	85.0	5.0	26.5	48.2	36.7	43.0	63.0	12.7
111	85.0	4.0	28.5	40.2	44.7	44.0	62.0	14.2
112	74.1	4.3	22.5	39.7	34.3	40.0	63.0	7.2
113	74.7	3.0	25.8	33.5	41.2	34.0	64.0	5.4
114	94.7	4.0	27.7	50.8	43.8	59.0	62.0	11.1
115	42.2	1.0	16.6	23.0	19.2	10.0	63.0	6.3
116	55.0	2.0	12.0	24.2	30.7	22.0	63.0	14.5
117	78.6	5.0	27.3	48.6	30.0	54.0	61.0	5.5
118	72.5	4.0	22.1	35.2	37.2	26.0	63.0	19.2
119	74.2	4.0	24.1	42.7	31.5	26.0	66.0	9.4
120	62.6	2.0	12.2	24.5	38.1	26.0	62.0	6.2
122	92.8	5.0	26.6	53.8	39.0	56.0	63.0	6.8
140	79.2	3.0	24.4	37.0	42.2	24.0	65.0	2.0
192	99.6	7.0	15.8	43.8	55.7	98.0	63.0	9.4
MEAN	72.2	3.0	21.9	37.6	34.6	37.0	61.0	10.1
SD	14.8	1.51	7.02	10.8	8.9	19.5	5.9	4.8

The results show that the entries in this study were of medium height and were less than 1m tall. The average branch number was 3 with values ranging from 0 for SPS SIK 72 to 8 for SPS SIK 03 and SPS SIK 028. On the average the lines had slightly more than 50% of the shoot bearing the capsules. The average capsule number per plant was 37 with a range from 12 capsules for SPS SIK 10(2) to 101 for SPS SIK 03. The average seed yield per plant was 10.1g. The highest seed yields were obtained from SPS SIK 028, SPS SIK 078, SPS SIK 081, SPS SIK 085, SPS SIK 091, SPS SIK 093, SPS SIK 096, SPS SIK 098, SPS SIK 099, SPS SIK 102, SPS SIK 192. Promising lines were selected based on vigour, capsule production, seed yield, lack of disease and pest infection and lack of lodging. The lines selected for further tests are enlisted in Table 4.2.6.

Table 4.2.6.: Promising line selections to be advanced for further tests

SPS SIK No.	SPS No.
SZ 3	046
01	050
03	051
04 X	070
07	072
010(2)	078
013	080
023	085
024	088
025	096
026	098
028	110
033	111
035	112
036	113
045	192

4.2.5. Disease resistance studies for varietal development

4.2.5.1 Materials and methods

Conditions influencing in vitro growth and sporulation of Cercospora sesami and C. sesamicola were investigated to determine appropriate techniques for producing adequate quantities of inocula for use in the creation of epiphytotic of the white and angular leaf spots of sesame in resistance screening experiments. The factors studied were media composition, media quality, media pH, incubation period, temperature, light regime, inoculation technique and subculturing. Isolates used in these studies were obtained from Siaya Farmer's Training Centre in Western Kenya.

Pathogenicity of C. sesami and C. sesamicola on cultivated sesame (Sesamum indium) and on three wild species of sesame (Sesamum calycinum, S. angolense and S. latifolium) were also investigated under glasshouse conditions to provide proof for pathogenicity and establish host range of the two fungi. Histopatholigical relationships of the two fungi were also investigated by inoculating susceptible sesame plants within the glasshouse.

White and angular leaf spots were monitored in plots of 16 sesame accessions at Siaya Farmers Training Centre and Kibwezi Dryland Research Field Station to determine relative susceptibility of the accessions to the two diseases. Area under disease progress curves and apparent rates of disease progress were computed from the disease severity using the procedure described by Shanner and Finney (1977) and the Johnson et al (1986).

4.2.5.2. Results

Both fungi produced the largest colonies, and the most abundant quality of conidia on carrot leaf decoction, potato dextrose agar and sesame stem meal agar, respectively. Optimum media quantity for growth of both fungi was 35ml per

9cm diameter petri-plate. C. sesami sporulated most abundantly in plates holding 15ml of media, but conidial production by C. sesamicola was maximum in those carrying 35ml.

Mycelial and conidial production by both fungi were influenced by an interaction between pH and incubation period. Optimum growth and sporulation of the fungi occurred between pH 6-7. Longer duration of incubation widened the pH range for maximum mycelial and conidial production by both fungi. Prolonged incubation also improved sporulation of C. sesami until 21 days after inoculation. For C. sesamicola, each increase in the duration of incubation enhanced sporulation.

Mycelial and conidial production by the two fungi were also affected by interaction of light and temperature. Optimum temperature for culturing both fungi was 25°C. At all temperatures below and including 30°C, maximum growth of both fungi was observed under continuous light; at 35°C, the process was favoured by continuous dark and 12 hours alternating light/dark cycles, but was depressed by continuous light. Sporulation of C. sesami was greater under continuous dark and alternating light/dark cycles at temperatures below and including 25°C; at higher temperatures, illumination treatments did not produce significant effects on conidial production. For C. sesamicola, the largest number of conidia was observed under continuous light at all the tested temperatures.

Growth of both fungi was also influenced by an interaction between inoculation technique and subculturing. The same interaction affected sporulation of C. sesami, but not that of C. sesamicola. Although colonies of both fungi were generally larger when propagated from mycelial fragments than from conidia, the converse case applied for sporulation. A general increase in growth of both fungi occurred following subculturing, irrespective of the form of inoculum used to initiate the cultures. Sporulation of the two fungi also followed a similar pattern when cultures were generated using conidia; for those grown using mycelial fragments, subculturing caused a general decline in sporulation of C. sesami, but improved it for C. sesamicola.

Within 12 to 28 days following inoculation, both fungi produced symptoms of infection on S. indicum, S. calycium and S. anglolense. However only C. sesamicola caused infection on S. latifolium. Spores of both fungi germinated to give 1 to 6 germ tubes per conidium within 3 to 12 hours from inoculation. Germ tubes of C. sesami were long and did not produce appressoria, in contrast to those of C. sesamicola which were shorter and formed appressoria, before penetration. Penetration of both fungi into host leaf tissues was via the stomata and occurred 12 to 36 hours after innoculation.

Increase in percentage of disease leaves and percent defoliation fit the Gompertz model more closely than the logistic model. Rates of disease increase in infected leaves and defoliation as well as areas under disease progress curves (AUDPCs) varied among the sesame accession studied. Sesame accessions with larger AUDPCs had generally faster rates of disease progress, although this was not always the case. The most susceptible accessions to both diseases were SPS 071 and SIK 134 (Table 4.2.7). Accession SPS 013, and accessions SIK 031 and SPS 045 exhibited the least susceptibility to white leaf spot, and angular leaf spot, respectively. These accessions are suggested as potential standards for comparing reaction of other genotypes to the respective diseases of sesame.

Table 4.2.7:

Mean area under disease progress[a] for percent diseased leaves (AUDPC-DL) and percent defoliation (AUDPC-DF) from field tests conducted on 16 sesame accessions at Kibwezi DRFS FTC and Siaya FTC in October, 1991 - February, 1992 to measure progress of white leaf spot and angular leaf spot.

	Area under disease progress curves for percent diseased leaves (AUDPC-DL)				Area under diseaseprogress curves for percent defoliation (AUDPC-DF)			
	White leaf spot		Angular leaf spot		White leaf spot		Angular leaf spot	
Accessions	Kibwezi	Siaya FTC	Kibwezi	Siaya FTC	Kibwezi	Siaya FTC	Kibwezi	Siaya FT
SIK 005	3615.97ab	3314.97abcd	3719.10bc	454.73bcde	1369.67bc	1263.73bc	767.67fg	760.90b
SIK 013	2357.13b	2173.97g	3687.13bc	3496.50bc	945.93defg	504.00e	1365.00d	246.87d
SIK 015	2603.77gh	2469.83efg	3978.10ab	3153.73bcde	1161.07cde	1290.10bc	890.40ef	1027.37a
SIK 031	2755.90efg	2463.06efg	3027.97e	2514.10h	663.83g	452.43e	217.93j	222.60d
SIK 093	3461.27bc	3345.77abc	3721.20bc	3432.57bcd	1428.93bc	1200.73bc	805.00f	185.97d
SIK 122	3026.10de	2994.60bcde	4344.60a	3087.93cdef	873.37efg	662.90e	491.63hi	260.63d
SIK 132	2866.26efg	2927.87bcde	4275.367a	4529.70a	1005.43ef	773.50dc	2578.33a	1068.20a
SIK 134	3860.50a	3587.03a	4269.307a	4419.10a	1161.07cde	1148.46bc	1891.63b	500.50c
SPS 005	2884.70defg	2854.37bcde	3421.37cde	3327.33bcde	1155.46cde	1050.23cd	600.13gh	518.47c
SPS 007	2639.00fgh	2682.17efg	3630.67bcd	3011.63defg	766.50fg	654.50e	540.17hi	344.40d
SPS 028	2877.93defg	2777.60cdef	3867.97ab	2966.60efg	1271.43bcd	1097.37cd	1008.47e	790.96b
SPS 045	3009.53def	2839.90bcde	3086.77e	2459.57h	1507.57b	1254.87bc	393.63ij	276.97d
SPS 071	3868.43a	3867.967a	3890.37ab	3563.23b	2311.63a	1981.00a	1596.23c	511.70c
SPS 089	3225.04cd	2236.96fg	3269.23cde	2671.67fgh	1114.19cde	780.50de	805.00f	756.00b
SPS 096	2649.50efgh	2736.30defg	3107.07e	2958.20efg	1585.03b	1459.03b	916.77ef	504.67c
SPS 113	3753.63ab	3408.53ab	3221.87de	2579.26gh	1355.90bc	1080.57cd	489.77hi	794.73b
Mean	3090.92	2917.56	3594.88	3226.64	1256.34	1040.87	965.58	518.77

[a]Average of 3 replications; within each experimental location, means followed by the same letter do not differ significantly at $p = 0.01$ (Duncan's multiple range test).

References

Johnson, C.S., Beute , M.k., and Ricker, M.D. 1986. Relationship between components of disease progress of early leaf spot on Virginia type peanut. Phytopathology, 76:495 - 499

Shanner, G., and Finney R.E. 1977. The effect of nitrogen fertilization on the expression of slow mildrewing resistance in know-wheat. Phytopathology, 67:1051 - 1056.

5. CONCLUSIONS

5.1. Conclusions from previous work

Based on the results of the first year studies (detailed in First Year Technical Report) and the second year studies we make the following conclusions.

(a) Farmers thin their sesame crop to 1 to 3 plants per hill with spacing of 60cm x 15cm.

(b) Little or no fertilizer be applied to sesame but the crop should be cultivated early in rotation when the soil still has good structure and not liable to compaction and water logging.

(c) Sesame be planted as a pure stand. It can be relayed with other crops so long as its planting is timed in such a way that it is not subjected to undue competition during early growth, flowering and seed filling. If it is relay planted with maize, as is the practice in Coast Province, it should be planted when maize is approaching maturity. That is about June/July when the long rains maize crop is about to mature.

(d) The sesame be planted during the main rains in CL_4 and CL_5 agroecozones of Kenya's Coast Province where the June/July rains are unreliable.

(e) As indices of plant water status, leaf water potential and leaf solute potential were not found useful in separating varieties but studies involving more genotypes should be instituted.

(f) The farmers continue cultivating the landrace cultivars in coast Province until better varieties are developed. (The project is in the process of developing superior varieties).

5.2. Recommendations for further research

(a) Further screening and selection of the identified promising cultivars for improved yield and disease resistance, especially Cercospora.

(b) Detatiled studies on nutrient and water requirements of sesame and the value of sesame as an intercrop component.

6. DISSEMINATION OF THE PROJECT RESULTS

1. A workshop was organised by thee project in August 1991 to present some of the projects preliminary findings and recommendations to sesame research workers and agricultural extension workers were drawn from the sesame growing areas of Coast Province. The extension workers were expected to pass the agronomic practices recommendations to the sesame farmers.

2. Some findings of the project were presented at an international oilcrops workshop in China in 1991.

3. The project investigators in collaboration with Kenya Agricultural Research Institute sesame researchers are preparing a handbook for

sesame production for use by extension workers and agricultural teaching institutions in Kenya.

7. TRAINING

The following M.Sc. students, registered at the University of Nairobi are affiliated to the project and undertook studies on specific topics for the benefit of the project.

1. Mr.James O. Nyanapah

    Topic: Cultural studies on Cercospora sesami, C. sesamicola and their interactions with 16 Sesamum indium (L) varieties.

2. Mr. D.A. Odeny

    Topic: Response of Sesame to Nitrogen and Phosphorus fertilizers.

3. Miss D.J. Tingos

    Topic: Responses of yields of Sesamum indicum (L) and Helianthus annuss (L) to soil water deficits.

4. Mr. Maimba, F.M.

    Topic: Evaluation of sesame genotypes for drought stress.

5. Macharo, T.M.

    Topic: Diallel analysis of metric traits in sesame.

Of these studies only one conducted by Mr. Nyanapah has been accomplished. The studies by Odeny and Miss Tingos are still in progress. Mr. Maimba and Mr. Mcharo have just started their work. The studies by Mr.Nyanapah, Mr. Mcharo and Mr. Maimba are a part of the varietal development experiments while those by Miss Tingos and Mr. Odeny are part of the agronomic experiments.

8. PROBLEMS ENCOUNTERED

1. There were serious administrative problems which the project underwent. It was not easy to obtain project funds from Egerton University. This led to this project report being late. Field experiments were also affected since we could not easily acquire labour.

2. Labour costs were quite high due to heavy weed infestation at Mtwapa.

3. The project found it difficult to compete for labour with other research institutions like I.C.I.P.E. which were also conducting their experiments at Mtwapa and had ready money to pay to the labourers. Such also paid higher wages to the labourers.

9. PROJECT PERSONNEL

Name	Institution	Role
Prof. J.A. Lugogo	Egerton University	Co-ordinator
Mr. T. Theora	Egerton University	Asst.Coordinator
Dr. P.O. Ayiecho	University of Nairobi	Project leader and Researcher (Breeder)
Dr. J.O. Nyabundi	University of Nairobi	Researcher (Agronomist)
Mr. K. W. Nyabundi	Egerton University	Research Assistant